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An analytical framework for interpreting appellate court data

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Abstract

The objective of this paper is to present a simple but flexible theoretical model of the adjudication process that can be used to derive implications of various hypotheses about the adjudicators and litigants for the trial win rates, appeal rates and the reversal rates. Such a model can serve as a helpful tool for guiding empirical work on attitudes and competency of adjudicators and litigants. We use the model to study how the appeal and reversal rates are affected by the litigants" perception that the trial court has a pro-plaintiff bias. We find that such a perception can result in higher appeal and reversal rates for the defendants relative to the plaintiffs, a pattern that is observed in the data.

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1. Introduction

The objective of this paper is to present a simple but flexible theoretical model of the adjudication process that can be used to derive implications of various hypotheses about the adjudicators and litigants for the trial win rates, appeal rates and the reversal rates. Such a model can serve as a helpful tool for guiding empirical work on attitudes and competency of adjudicators and litigants. We first present the model and then illustrate its use by studying how the appeal and reversal rates are affected by the litigants' perception that the trial court has a pro-plaintiff bias.

We find that such a perception can result in higher appeal and reversal rates for defendants relative to plaintiffs,[1] a pattern that is observed in the Supplemental Survey of Civil Appeals, 2001 data (see Appendix B for the relevant descriptive statistics). Based on this pattern and on an informal discussion of alternative hypotheses, Clermont and Eisenberg (2001) and Eisenberg and Heise (2009) conclude that the appellate courts are more likely to decide against plaintiffs because they *incorrectly* perceive the trial court as having a pro-plaintiff bias (which they refer to as "plaintiphobia"). By showing that the said pattern is consistent with another hypothesis, our analysis suggests that the conclusion of "plaintiphobia" drawn by these two papers does not necessarily follow.

While in this paper we only consider the effect of litigants' perception of trial court bias on the appeal rates and reversal rates, our model can also be easily adapted to study the implications of many other commonly held opinions about the adjudicators and litigants. Some examples are: allegations that juries have a pro-plaintiff bias, that juries are more likely to make errors than trial judges or that trial judges receive a more pro-plaintiff case mix compared to juries.

Cameron and Kornhauser (2006), Daughety and Reinganum (2000), Shavell (1995, 2006) and Spitzer and Talley (2000) also provide models of the adjudication process involving both trial and appeal. The objective of these scholars, however, is quite different from our objective. We are interested in deriving the implications of various opinions about the adjudicators and litigants for trial win rates, appeal rates and reversal rates. Cameron and Kornhauser (2006) and Shavell (1995) are concerned with the optimality of the judicial structure. Daughety and Reinganum (2000) explore whether a litigant's decision to bring an appeal carries information that can improve the appellate court's decision when the litigant knows that the appellate court would draw an inference about the correct legal rule based on her decision to appeal.

There are many differences between our model and those in these papers. None of these papers allows for heterogeneity in the cost of appeal, nor do they allow for the trial court's decision to affect litigants' beliefs about the correct outcome. Hence, the litigants' perception of trial court bias plays no role in these models. Also, these models do not conduct a comparative analysis of plaintiffs and defendants.

[1] In our model, the perception by the litigants that the trial court has a pro-plaintiff bias unambiguously increases the defendant appeal rate and decreases the plaintiff appeal rate. The impact on the reversal rates, however, is ambiguous. It depends upon how the perception of the bias affects the beliefs of the defendants and plaintiffs.

The paper proceeds as follows. In Section 2 we present our model, in Section 3 we derive the expressions for trial win rates, appeal rates and reversal rates and compare these across defendants and plaintiffs both when litigants do and do not perceive trial court as being pro-plaintiff. Section 4 concludes. The proofs are in Appendix A and descriptive statistics are in Appendix B.

2. The Model

Consider a situation where risk neutral litigants go to a trial. Assume that in any particular trial there are only two possible verdicts, a correct and an incorrect verdict. The dispute could be about the liability of the defendant, in which case the two verdicts are whether the defendant is innocent or guilty. Alternatively, the issue could be about the level of damages and the two verdicts are whether the damages are low or high. We should clarify that the correctness of the verdict may not always correspond to the truth in a particular case. For example, in a particular case it may be socially optimal to find a defendant guilty only if at least two of the three pieces of evidence — e_1, e_2 and e_3 — are available.[2] In a case of this type, if only one piece of evidence, say e_1, is available then by a correct verdict we mean the verdict of "innocent", even if the defendant is actually guilty. Let S denote the state of nature. If the *correct* outcome, as defined here, is that the defendant be deemed innocent (resp. guilty) or that the damages awarded be low (resp. high), then $S = S_0$ (resp. $S = S_1$). Let r (resp. $1 - r$) denote the fraction of disputes in which $S = S_0$ (resp. $S = S_1$).

The Trial Court: The objective of the trial court is to render the correct decision, as defined above. Let V_T denote the trial court verdict. With some abuse of notation, let $V_T = S_0$ (resp. $V_T = S_1$) when the trial court renders a verdict in favor of the defendant (resp. plaintiff). Let $t_{ij} = \Pr(V_T = S_i|S = S_j)$, $(i, j \in \{0, 1\})$, denote the probability that an *unbiased* trial court renders a verdict of S_i when the state of nature is S_j. Note that $t_{10} = 1 - t_{00}$ and $t_{01} = 1 - t_{11}$. We assume that $t_{00} > 1/2$, $t_{11} > 1/2$ and $t_{00} = t_{11}$.

Assumption $t_{ii} > 1/2, \quad i \in \{0, 1\}$ says that an unbiased trial court's accuracy is greater than what it would be if it made a decision based solely on, say, a toss of a coin. Assumption $t_{00} = t_{11}$ says that the probability that an unbiased trial court decides in favor of the defendant, when that is the correct outcome, is the same as the probability that the trial court finds in favor of the plaintiff, when that is the correct outcome.[3,4]

[2] This may be socially optimal, for example, because considering only one piece of evidence sufficient to render a guilty verdict may result in many actually innocent defendants being deemed guilty and the likelihood of only one piece of evidence being present when the defendant is actually guilty may be relatively low.

[3] Note that this assumption *is not* saying that the probability of finding a defendant guilty when he is truly guilty is the same as probability of finding a defendant innocent when he is truly innocent. These probabilities may depend on the evidentiary standard. For example, in case of a strong evidentiary standard such as "beyond a resonable doubt", t_{11} may be much smaller than t_{00}. What assumption $t_{00} = t_{11}$ is saying is that the likelihood that an unbiased trial court will *correctly* render a guilty verdict is the same as the likelihood that an unbiased trial court will *correctly* render an innocent verdict.

[4] This representation of the trial court decision making can be easily modified to account for trial court bias or competency. For example, if the trial court has a pro-plaintiff bias, then we can define $t^B_{0j} = t_{0j} - \beta_j$ and $t^B_{1j} = t_{1j} + \beta_j$ for $j \in \{0, 1\}$, where β_j represents the extent of the bias. The effect of differences in competency can be investigated by allowing t_{00} and t_{11} to increase or decrease together.

The Appellate Court: As in the case of trial court, the appellate court's objective is to render the correct decision. Assume that the appellate court engages in a *de-novo* review of the trial court decision.[5] That is, it makes its decision solely based on the evidence; it does not consider the trial court's verdict. Let V_A denote the appellate court verdict. With some abuse of notation, let $V_A = S_0$ (resp. $V_A = S_1$) when the appellate court renders a verdict in favor of the defendant (resp. plaintiff). Let $a_{ij} = \Pr(V_A = S_i|S = S_j)$, $(i, j \in \{0, 1\})$. We assume that the accuracy of the appellate court's decision is such that $a_{00} > 1/2$, $a_{11} > 1/2$ and $a_{00} = a_{11}$. These assumptions are similar to those made in the case of the trial court.

The Litigants: We only consider the litigants' decision after the trial court renders its verdict. We treat the decision to go to trial as exogenous. We assume that the losing litigant appeals whenever the expected gain from appeal exceeds the cost of appeal. Let q_D^0 (resp. q_P^0) denote the defendant's (resp. plaintiff's) belief that the state is S_0 when it is, in fact, S_0. Let q_D^1 (resp. q_P^1) denote the defendant's (resp. plaintiff's) belief that the state is S_0 when it is S_1. After learning of the trial court decision, both plaintiffs and defendants update their beliefs about S. For $i, j \in \{0, 1\}$, let $\hat{q}_D^{ij}$ (resp. $\hat{q}_P^{ij}$) denote the defendant's (resp. plaintiff's) posterior belief that the state is S_0 when it is, in fact, S_j and the trial court verdict, V_T, is S_i. We assume the following:

(A.1) $\hat{q}_D^{10} = q_D^0 - \varepsilon_D^0$; $\hat{q}_D^{11} = q_D^1 - \varepsilon_D^1$, for some $\varepsilon_D^0 \geq 0$ and $\varepsilon_D^1 \geq 0$.
(A.2) $\hat{q}_P^{00} = q_P^0 + \varepsilon_P^0$; $\hat{q}_P^{01} = q_P^1 + \varepsilon_P^1$, for some $\varepsilon_P^0 \geq 0$ and $\varepsilon_P^1 \geq 0$.

Assumption (A.1) says that a trial court decision in the plaintiff's favor decreases the defendant's belief that the state is S_0. Assumption (A.2) says that a trial court decision in the defendant's favor increases the plaintiff's belief that the state is S_0.[6]

If the defendants (resp. the plaintiffs) perceive the trial court as biased, then their posterior beliefs are denoted by $\hat{q}_D^{ijB}$ (resp. $\hat{q}_P^{ijB}$) and, as in (A.1) and (A.2), we assume

(A.3) $\hat{q}_D^{10B} = q_D^0 - \varepsilon_D^{0B}$; $\hat{q}_D^{11B} = q_D^1 - \varepsilon_D^{1B}$, for some $\varepsilon_D^{0B} \geq 0$ and $\varepsilon_D^{1B} \geq 0$.
(A.4) $\hat{q}_P^{00B} = q_P^0 + \varepsilon_P^{0B}$; $\hat{q}_P^{01B} = q_P^0 + \varepsilon_P^{1B}$, for some $\varepsilon_P^{0B} \geq 0$ and $\varepsilon_P^{1B} \geq 0$.

Assumptions (A.1)-(A.4) allow for the possibility that the extent of change in the litigants' beliefs, following the trial court's decision, can be different when the litigants perceive the trial court as having a pro-plaintiff bias and when they do not have such a perception. We assume that $\varepsilon_D^{iB} \leq \varepsilon_D^i$ and $\varepsilon_P^{iB} \geq \varepsilon_P^i$ for $i \in \{0, 1\}$. This says that the defendants (resp. plaintiffs) give a smaller (resp. greater) weight to a trial court's decision in favor of the plaintiff (resp. defendant) when they perceive the trial court as having a pro-plaintiff bias.[7]

[5] This assumption is also made by Shavell (1995) and Daughety and Reinganum (2000). Further, it can be shown that a Bayesian model of the appellate court (where the appellate court updates its beliefs about the state of nature, S, based on its own signal about S and the trial court's decision) gives the same result. Proof is available from authors upon request.

[6] An alternative way of modeling the updating of beliefs is to assume standard Bayesian updating where, for example, $\hat{q}_D^{10} = q_D^0 t_{10}/(q_D^0 t_{10} + (1 - q_D^0)t_{11})$. Note, however, that this does not capture the fact that the updated beliefs would also reflect any new information discovered by the litigants during the trial. The form of updating that we assume can be considered as a shortcut to a more elaborate model of belief-updating that accounts for discovery of any new information during the trial.

[7] Assumptions (A.1)-(A.4) and assumptions $\varepsilon_D^{iB} \leq \varepsilon_D^i$ and $\varepsilon_P^{iB} \geq \varepsilon_P^i$ are reasonable only if our earlier assumption about the court's accuracy, $t_{ii} > 1/2$ for $i \in \{0, 1\}$, also holds. If $t_{ii} < 1/2$, (A.1)-(A.4)

Let H_0 (resp. H_1) denote the damages awarded by the trial court when it decides in the defendant's (resp. the plaintiff's) favor. If the dispute is about liability then $H_0 = 0$, and if it is about the level of damages, for example, whether punitive damages should be imposed or not, then H_0 can be positive. In any case, $H_0 < H_1$. Let $\Delta H = H_1 - H_0$. Also, assume that the litigants are aware of the accuracy of the appellate court's decision, which we have referred to as a_{ij} $(i, j \in \{0, 1\})$. From these assumptions, it follows that if the state is S_i $(i \in \{0, 1\})$ and the defendant loses in the trial court, then his expected gain from an appeal is

$$EG_D^i = (\hat{q}_D^{1i} a_{00} + (1 - \hat{q}_D^{1i}) a_{01}) \Delta H \tag{1}$$

when he perceives the trial court as unbiased and,

$$EG_D^{iB} = (\hat{q}_D^{1iB} a_{00} + (1 - \hat{q}_D^{1iB}) a_{01}) \Delta H \tag{2}$$

when he perceives the trial court as biased. Similarly, if the state is S_i $(i \in \{0, 1\})$ and the plaintiff loses in the trial court, then her expected gain from an appeal is,

$$EG_P^i = (\hat{q}_P^{0i} a_{10} + (1 - \hat{q}_P^{0i}) a_{11}) \Delta H \tag{3}$$

when she perceives the trial court as unbiased and,

$$EG_P^{iB} = (\hat{q}_P^{0iB} a_{10} + (1 - \hat{q}_P^{0iB}) a_{11}) \Delta H \tag{4}$$

when she perceives the trial court as biased. The losing litigant compares the expected gain from appeal with the cost of appeal and files an appeal whenever the former is higher.

To focus on how a perception of the trial court bias affects the appeal and reversal rates, we assume that there are no differences in other factors that may influence these rates, such as in competency or in the cost of appeal across plaintiffs and defendants. Denote by $F(\cdot)$ the distribution of the litigants' cost of appeal. Then the probability of appeal given a defendant (resp. plaintiff) loss is $F(EG_D^0)$ (resp. $F(EG_P^0)$) when the state is S_0; and $F(EG_D^1)$ (resp. $F(EG_P^1)$) when the state is S_1. Also assume

(A.5) $q_D^0 = 1 - q_P^1$ and $q_D^1 = 1 - q_P^0$.
(A.6) $\varepsilon_P^0 = \varepsilon_D^1$ and $\varepsilon_P^1 = \varepsilon_D^0$.

Assumption (A.5) says that the prior belief of the defendant that he should win the trial, when that is the correct (resp. not the correct) outcome, is the same as the prior belief of the plaintiff that she should win the trial when that is the correct (resp. not the correct) outcome. The first equality in Assumption (A.6) states that, when the trial court correctly rules against the defendant, he adjusts his belief by a magnitude that is equal to the adjustment made by the plaintiff when the trial court correctly rules against her. The second equality pertains to adjustments when the trial court rules incorrectly and can be similarly explained.

3. Implications for Trial Win Rates, Appeal Rates and Reversal Rates

We first show that if the litigants do not perceive the trial court to be pro-plaintiff, and if the case-mix at the trial level is symmetric (neither pro-plaintiff nor pro-defendant), then

would need to be changed. For example, in place of (A.1) and (A.3) it would be more reasonable to have $\hat{q}_D^{10} = q_D^0 + \varepsilon_D^0$, $\hat{q}_D^{11} = q_D^1 + \varepsilon_D^1$, $\hat{q}_D^{10B} = q_D^0 + \varepsilon_D^{0B}$ and $\hat{q}_D^{11B} = q_D^1 + \varepsilon_D^{1B}$, along with $\varepsilon_D^{iB} \geq \varepsilon_D^i$. That is, when the trial court is more likely to be incorrect than correct, its decision in the plaintiff's favor will result in an upward adjustment in the defendant's belief that the state is S_0. Moreover, this increase is likely to be larger when the defendant believes that the trial court has a pro-plaintiff bias.

both the plaintiffs and the defendants have the same appeal and reversal rates. With this result as the benchmark, we then evaluate how the appeal and reversal rates are affected by litigants' perception that the trial court has a pro-plaintiff bias, and discuss conditions under which this perception results in the pattern observed in the Supplemental Survey of Civil Appeals data. Let us first derive the expressions for these rates.

Trial Win Rates: The defendants' trial win rate is $rt_{00} + (1-r)t_{01}$. In fraction r (resp. $1-r$) of cases, the correct outcome is in the defendants' (resp. plaintiffs') favor; of these cases, the trial court decides fraction t_{00} (resp. t_{01}) in the defendants' favor. Hence, of all the cases, fraction $rt_{00} + (1-r)t_{01}$ are decided in the defendant's favor. Plaintiffs' trial win rate can be similarly determined and is given by $rt_{10} + (1-r)t_{11}$.

Appeal Rates: The defendants' appeal rate (of the cases that the defendants lose, the fraction in which they appeal) when the trial court is unbiased and when the litigants perceive no bias is given by

$$\Pr(\text{D appeal}|\text{D loss}) = [rt_{10}F(EG_D^0) + (1-r)t_{11}F(EG_D^1)]/[rt_{10} + (1-r)t_{11}]. \tag{5}$$

The numerator is the joint probability of the defendant losing and appealing the trial court outcome and the denominator is the marginal probability of the defendant losing a case. The plaintiffs' appeal rate (of the cases that the plaintiffs lose, the fraction in which they appeal) in the absence of any actual or perceived bias is:

$$\Pr(\text{P appeal}|\text{P loss}) = [rt_{00}F(EG_P^0) + (1-r)t_{01}F(EG_P^1)]/[rt_{00} + (1-r)t_{01}]. \tag{6}$$

If the trial court is unbiased but the litigants believe that there is a pro-plaintiff bias then the appeal rates of the defendants and plaintiffs are

$$\Pr(\text{D appeal}|\text{D loss}) = [rt_{10}F(EG_D^{0B}) + (1-r)t_{11}F(EG_D^{1B})]/[rt_{10} + (1-r)t_{11}] \tag{7}$$

and,

$$\Pr(\text{P appeal}|\text{P loss}) = [rt_{00}F(EG_P^{0B}) + (1-r)t_{01}F(EG_P^{1B})]/[rt_{00} + (1-r)t_{01}] \tag{8}$$

respectively.

Reversal Rates: The reversal rate of the defendants (the fraction of all defendant appeals that are reversed) when the trial court is unbiased and the litigants do not perceive any bias is given by

$$\Pr(\text{Reversal}|\text{D Appeal}) = \frac{rt_{10}F(EG_D^0)a_{00} + (1-r)t_{11}F(EG_D^1)a_{01}}{rt_{10}F(EG_D^0) + (1-r)t_{11}F(EG_D^1)}. \tag{9}$$

The numerator is the joint probability of a defendant appeal and a reversal and the denominator is the marginal probability of defendant appeal. The reversal rate for the plaintiffs in the absence of any actual or perceived bias is

$$\Pr(\text{Reversal}|\text{P Appeal}) = \frac{rt_{00}F(EG_P^0)a_{10} + (1-r)t_{01}F(EG_P^1)a_{11}}{rt_{00}F(EG_P^0) + (1-r)t_{01}F(EG_P^1)}. \tag{10}$$

If the trial court is unbiased, but the litigants perceive a pro-plaintiff bias, then the reversal rates are given by

$$\Pr(\text{Reversal}|\text{D Appeal}) = \frac{rt_{10}F(EG_D^{0B})a_{00} + (1-r)t_{11}F(EG_D^{1B})a_{01}}{rt_{10}F(EG_D^{0B}) + (1-r)t_{11}F(EG_D^{1B})} \tag{11}$$

and,

$$\Pr(\text{Reversal}|\text{P Appeal}) = \frac{rt_{00}F(EG_P^{0B})a_{10} + (1-r)t_{01}F(EG_P^{1B})a_{11}}{rt_{00}F(EG_P^{0B}) + (1-r)t_{01}F(EG_P^{1B})} \tag{12}$$

for the defendants and plaintiffs, respectively. Using these expressions we have

Proposition 1 (**Benchmark Case**). *If the litigants do not perceive the trial court as biased and the case-mix is symmetric, then the trial win rates, appeal rates and the reversal rates are the same for both the plaintiffs and the defendants.*

Symmetric Case-mix but a Perception of Trial Court Bias by the Litigants

Now suppose that the litigants perceive a trial court bias, but all the other conditions remain the same as in the benchmark case.[8] As noted above, we allow for the perception of bias to influence the amount by which the litigants adjust their belief that the state is S_0, when the trial court rules against them. Denote by $\delta_0 = \varepsilon_D^0 - \varepsilon_D^{0B}$ and $\delta_1 = \varepsilon_D^1 - \varepsilon_D^{1B}$ the *decrease* in the downward adjustment in belief of the defendants in state S_0 and S_1 respectively. Similarly, denote by $\gamma_0 = \varepsilon_P^{0B} - \varepsilon_P^0$ and $\gamma_1 = \varepsilon_P^{1B} - \varepsilon_P^1$ the *increase* in the upward adjustment in belief of the plaintiffs in state S_0 and S_1 respectively. Then we have the following.

Proposition 2. *A perception by the litigants that the trial court has a pro-plaintiff bias results in,*

(a) a higher (resp. lower) appeal rate of the defendants (resp. plaintiffs).
(b) a higher (lower) reversal rate of the defendants if

$$\delta_0 \frac{f(EG_D^{0B})}{F(EG_D^{0B})} > (<) \delta_1 \frac{f(EG_D^{1B})}{F(EG_D^{1B})} \tag{13}$$

(c) a higher (lower) reversal rate of the plaintiffs if

$$\gamma_0 \frac{f(EG_P^{0B})}{F(EG_P^{0B})} > (<) \gamma_1 \frac{f(EG_P^{1B})}{F(EG_P^{1B})} \tag{14}$$

The intuition behind the proposition is the following. First, consider part (a). When the trial court rules against the defendants (resp. plaintiffs), they adjust their prior belief that $S = S_0$ downwards (resp. upwards). This adjustment is smaller (resp. larger) when they perceive the trial court as having a pro-plaintiff bias. Thus, with such a perception their expected gain from appeal is higher (resp. lower), which results in more (resp. less) appeals.

The intuition behind part (b) is the following. As we see in part (a), the appeal rate of the defendants goes up when they perceive the trial court as biased. If the appeal rate of the defendants who deserve to win ("innocent" defendants) increases by a greater proportion than that of those who deserve to lose ("guilty" defendants) then the reversal rate goes up. This is what is expressed in inequality (13). Now for most distribution functions, $f(x)/F(x)$

[8] Eisenberg and Heise (2009) comment that "even if the trial court bias does not exist, appellate courts may believe that such a bias exists ... [due to] persistent public characterizations of a "liability crisis" ". If this is true, then it seems reasonable to think that even the litigants may believe that such a bias exists. Eisenberg and Heise (2009) do not consider this possibility.

is decreasing in x, that is $f(EG_D^{0B})/F(EG_D^{0B}) < f(EG_D^{1B})/F(EG_D^{1B})$. Hence, for the reversal rate to increase with the perception of bias, we need δ_0 to be sufficiently larger than δ_1.

Here we outline a rationale for why δ_0 is likely to be greater than δ_1. In state S_1, when the correct outcome is that the defendant be deemed guilty, it is more likely that there is sufficient objective evidence against the defendant. Thus, according to the defendant, any bias that he perceives is less likely to have been the deciding factor in the trial court's decision making. Therefore, the adjustment in his belief about the state of nature, when the trial court rules against him in state S_1, will be similar whether or not he perceives the trial court as biased, i.e., δ_1 will be small. On the other hand, in state S_0 there is less likely to be compelling evidence against the defendant. Therefore, when the trial court rules against him and he perceives a bias, he is more likely to consider the bias as being a deciding factor. Hence, the amount by which he adjusts his belief about the state of nature (when the trial court rules against him in state S_0) will be quite different depending upon whether or not he perceives the trial court as biased, i.e., δ_0 will be relatively large.[9]

The intuition behind part (c) is similar to that behind part (b). For γ_1 sufficiently greater than γ_0, the plaintiff reversal rate will be *smaller* when they perceive a pro-plaintiff bias.[10]

Taken together, propositions 1 and 2 suggest that when the litigants perceive the trial court to be pro-plaintiff, the defendant appeal and reversal rates can be higher compared to those of the plaintiffs. That is, it is possible that a perception of a pro-plaintiff bias, by the litigants only, results in the same pattern that we observe in the data. Hence, the interpretation in Eisenberg and Heise (2009) that this pattern is evidence of the appellate court's "plaintiphobia" is not justified unless one can rule out this alternative explanation.

4. Conclusion

Data sets that follow a comprehensive cohort of court cases from the trial stage to their conclusion at the appellate stage seem to offer new opportunities for empirical work on attitudes and competency of adjudicators and litigants. In this paper we present a model of the judicial process that can serve as a helpful tool in guiding such empirical work. We demonstrate how the model can be used by studying the effect of litigants' perception that the trial court has a pro-plaintiff bias on appeal rates and reversal rates. We find that such a perception results in a higher defendant appeal rate relative to that of the plaintiffs and can also result in defendants having a higher reversal rate. Eisenberg and Heise(2009) interpret the higher defendant reversal rate that is seen in the data as being evidence of a pro-defendant bias at the appellate level. By showing that this pattern is consistent with another

[9] Proposition 2 and the above discussion would also be valid when $t_{ii} < 1/2$, provided we change assumptions (A.1)-(A.4) as mentioned in footnote 7 and redefine $\delta_i = \varepsilon_D^{iB} - \varepsilon_D^{i}$ and $\gamma_i = \varepsilon_P^{i} - \varepsilon_P^{iB}$ for $i \in \{0,1\}$. In this case, δ_i would reflect the *increase* (due to bias) in upward adjustment in the defendants' belief that the state is S_0 when the trial court rules against him in state S_i. Analogous change applies to the interpretation of γ_i.

[10] A similar rationale as in the case of δ_0 and δ_1 can be given for why γ_1 is likely to be greater than γ_0. A plaintiff's perception of the trial court is likely to play a bigger role in her adjustment of beliefs when the evidence is more unclear. The parameter γ_1 corresponds to the *change* in adjustment when the trial court makes an error (the state is S_1 but the trial court rules in the defendant's favor), which is more likely to happen when the evidence or rules are unclear.

hypothesis, our model suggests that the conclusion drawn by Eisenberg and Heise(2009) does not necessarily follow from the data.

The model presented here can be easily adapted to study how other factors, such as actual trial court bias, differences in attitudes of juries and trial judges, differences in their competency, and asymmetric stakes of litigants can affect appeal rates and reversal rates. We are currently working on some of these applications. In future work, the model can be improved by allowing for settlement at the appellate stage, and also by explicitly considering the litigation/settlement decision before the trial stage.

Appendix A: Proofs

Here we provide proofs of the propositions stated in the main body of the paper.

Proof of Proposition 1

Using equation (1) and assumption (A.1), we can express the defendant's gain from appeal as $EG_D^0 = [(q_D^0 - \varepsilon_D^0)a_{00} + (1 - q_D^0 + \varepsilon_D^0)a_{01}](H_1 - H_0)$. Using assumption $a_{00} = a_{11}$, (A.5) and (A.6), this expression equals $[(1 - q_P^1 - \varepsilon_P^1)a_{11} + (q_P^1 + \varepsilon_P^1)a_{10}](H_1 - H_0)$. From assumption (A.2) and equation (3), this is the same as EG_P^1. Similarly, it can be shown that $EG_D^1 = EG_P^0$. With $EG_D^0 = EG_P^1$, $EG_D^1 = EG_P^0$, the assumption of symmetric case-mix (which implies $r = 0.5$), and the assumption $t_{00} = t_{11}$, we have

$$rt_{10}F(EG_D^0) + (1 - r)t_{11}F(EG_D^1) = (1 - r)t_{10}F(EG_P^1) + rt_{00}F(EG_P^0),$$

$$rt_{00} + (1 - r)t_{01} = (1 - r)t_{11} + (r)t_{10}$$

and,

$$rt_{10}F(EG_D^0)a_{00} + (1 - r)t_{11}F(EG_D^1)a_{01} = (1 - r)t_{01}F(EG_P^1)a_{11} + rt_{00}F(EG_P^P)a_{10}.$$

The second equality implies that trial win rate of the defendants and the plaintiffs is the same. From the first two equalities and expressions (5) and (6) it follows that Pr(D appeal|D loss) = Pr(P appeal|P loss). Finally, from all the three equalities and expressions (9) and (10), it follows that Pr(Reversal|D appeal) = Pr(Reversal|P appeal). ■

Proof of Proposition 2

Part (a): Defendants' appeal rate

Using the definitions of δ_0 and δ_1, we can express EG_D^{0B} and EG_D^{1B} as, $EG_D^{0B} = EG_D^0 + (a_{00} - a_{01})\delta_0(\Delta H)$ and $EG_D^{1B} = EG_D^1 + (a_{00} - a_{01})\delta_1(\Delta H)$. Substituting these expressions in equation (7) we have

$$\Pr(\text{D appeal}|\text{D loss}) = \frac{rt_{10}F(EG_D^0 + (a_{00} - a_{01})\delta_0(\Delta H)) + (1 - r)t_{11}F(EG_D^1 + (a_{00} - a_{01})\delta_1(\Delta H))}{rt_{10} + (1 - r)t_{11}} \quad (15)$$

Differentiating (15) with respect to δ_0, we have

$$(d/d\delta_0)[\Pr(\text{D appeal}|\text{D loss})] \propto rt_{10}f(EG_D^0 + (a_{00} - a_{01})\delta_0(\Delta H))(a_{00} - a_{01}), \quad (16)$$

which is positive for $a_{00} > 1/2$. That is, the appeal rate increases as δ_0 increases. Similarly, we can show that the appeal rate increases as δ_1 increases.

Part (a): Plaintiffs' appeal rate

Using the definitions of γ_0 and γ_1, we can express EG_P^0 and EG_P^1 as, $EG_P^{0B} = EG_P^0 - \gamma_0(a_{11} - a_{10})\Delta H$ and $EG_P^{1B} = EG_P^1 - \gamma_1(a_{11} - a_{10})\Delta H$. Substituting these expressions in equation (8) we have

$$\Pr(\text{P appeal}|\text{P loss}) = \frac{rt_{00}F(EG_P^0 - \gamma_0(a_{11} - a_{10})\Delta H) + (1-r)t_{01}F(EG_P^1 - \gamma_1(a_{11} - a_{10})\Delta H)}{rt_{00} + (1-r)t_{01}} \quad (17)$$

Differentiating 17 with respect to γ_0, we have

$$(d/d\gamma_0)[\Pr(\text{P appeal}|\text{P loss})] \propto rt_{00}f(EG_P^0 - \gamma_0(a_{11} - a_{10})\Delta H)(a_{10} - a_{11}),$$

which is negative. That is, the plaintiffs' appeal rate falls as γ_0 increases. Similarly, we can show that the appeal rate decreases as γ_1 increases.

Part (b): Defendants' Reversal Rate

Substituting $EG_D^{0B} = EG_D^0 + (a_{00} - a_{01})\delta_0(\Delta H)$ and $EG_D^{1B} = EG_D^1 + (a_{00} - a_{01})\delta_1(\Delta H)$ in equation (11) we have

$$\Pr(\text{Reversal}|\text{D Appeal}) = \frac{rt_{10}a_{00}F(EG_D^0 + (a_{00} - a_{01})\delta_0(\Delta H)) + (1-r)t_{11}a_{01}F(EG_D^1 + (a_{00} - a_{01})\delta_1(\Delta H))}{rt_{10}F(EG_D^0 + (a_{00} - a_{01})\delta_0(\Delta H)) + (1-r)t_{11}F(EG_D^1 + (a_{00} - a_{01})\delta_1(\Delta H))} \quad (18)$$

Totally differentiating this expression with respect to δ_0 and δ_1, and using $t_{10} = 1 - t_{00}$, $t_{11} = t_{00}$, $a_{01} = 1 - a_{11}$ and $a_{00} = a_{11}$ we have[11]

$$d\Pr(\text{Reversal}|\text{D appeal}) \propto r(1-r)(2a_{00} - 1)^2 t_{00}(1 - t_{00})[F(EG_D^{1B})f(EG_D^{0B})\delta_0 - F(EG_D^{0B})f(EG_D^{1B})\delta_1]. \quad (19)$$

Expression in (19) is positive (negative) if and only if:

$$\delta_0 \frac{f(EG_D^{0B})}{F(EG_D^{0B})} > (<) \delta_1 \frac{f(EG_D^{1B})}{F(EG_D^{1B})}.$$

Part (c): Plaintiffs' Reversal Rate

Substituting $EG_P^{0B} = EG_P^0 - \gamma_0(a_{11} - a_{10})\Delta H$ and $EG_P^{1B} = EG_P^1 - \gamma_1(a_{11} - a_{10})\Delta H$ in equation (12) we can express the plaintiff reversal rate as

$$\Pr(\text{Reversal}|\text{P Appeal}) = \frac{rt_{00}F(EG_P^0 - \gamma_0(a_{11} - a_{10})\Delta H)a_{10} + (1-r)t_{01}F(EG_P^1 - \gamma_1(a_{11} - a_{10})\Delta H)a_{11}}{rt_{00}F(EG_P^0 - \gamma_0(a_{11} - a_{10})\Delta H) + (1-r)t_{01}F(EG_P^1 - \gamma_1(a_{11} - a_{10})\Delta H)} \quad (20)$$

[11] We have set $d\delta_i = \delta_i, (i \in \{0, 1\})$ in expression (19).

Totally differentiating this expression with respect to γ_0 and γ_1 and using $t_{01} = 1 - t_{11}$, $t_{11} = t_{00}$, $a_{10} = 1 - a_{00}$ and $a_{11} = a_{00}$ we have

$$d\,\Pr(\text{Reversal}|\text{P appeal}) \propto$$
$$r(1-r)(1-2a_{00})^2 t_{00}(1-t_{00})[f(EG_P^{0B})F(EG_P^{1B})\gamma_0 - f(EG_P^{1B})F(EG_P^{0B})\gamma_1] \quad (21)$$

The expression in (21) is positive (negative) if and only if

$$\gamma_0 \frac{f(EG_P^{0B})}{F(EG_P^{0B})} > (<) \gamma_1 \frac{f(EG_P^{1B})}{F(EG_P^{1B})}. \qquad \blacksquare$$

Appendix B: Data

The patterns in the data that we refer to in the main body are based on the Supplemental Survey of Civil Appeals, 2001. Here we show the summary statistics pertaining to the trial win rates, appeal rates and reversal rates of the defendants and the plaintiffs from this data set. These statistics are the same as those used by Eisenberg and Heise (2009) to motivate their hypothesis that appellate courts exhibit "plaintiphobia".

Of the initial 8,038, we eliminated 165 civil trial cases in which both litigants appealed. We eliminated 10 cases for which the trial outcome was missing. This gives a total of 7,863 cases. The trial win rate for the defendants is defined as (Total # of Trials Won by the Defendant)/(Total # of Trials). The trial win rate of the plaintiffs is similarly defined. Of the 7,863 trials, 991 (12.6%) were appealed. As Table 1 shows, the appeal rate for the defendants is higher than that of the plaintiffs. The appeal rate for defendants is defined as

$$\text{Defendant Appeal Rate} = \frac{\text{Total \# of Defendant Appeals}}{\text{Total \# of Cases in which Defendants Lose}} \quad (22)$$

The appeal rate for the plaintiffs is similarly defined. The defendants brought 573 (57.8%) of the 991 cases appealed.

We categorize a case as being reversed if it was "reversed in whole" or "reversed in part" or "remanded" or "affirmed in part". The reversal rate for the defendants is defined as

$$\text{Defendant Reversal Rate} = \frac{\text{Total \# of Defendant Appeals Reversed}}{\text{Total \# of Defendant Appeals}} \quad (23)$$

The reversal rate for the plaintiffs is similarly defined.

Table 1: Trial win, appeal and reversal rates of Defendants and Plaintiffs

Party	Trial Win Rate	Appeal Rate	Reversal Rate
Defendants	46.3	13.6	34.3
Plaintiffs	53.7	11.5	23.7
p-value[a]	0.000	0.000	0.000

[a] p-value is the probability value for the t-test of the difference between the defendant and the plaintiff rates.

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